

State of South Dakota
Nils Boe, Governor

Minerals Report 13

THE MINERAL INDUSTRY
OF SOUTH DAKOTA
IN 1965

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The Mineral Industry of South Dakota

This chapter has been prepared under a cooperative agreement between the Bureau of Mines, U.S. Department of the Interior, and the South Dakota State Geological Survey for collecting information on all minerals except fuels.

By R. B. Stotelmeyer,¹ William C. Henkes,² and Duncan J. McGregor³

Mineral production valued at \$50.2 million, declined for the second year from the record high of \$54.1 million recorded in 1963. Decreased demand for some mineral products resulted in a 5-percent decline in value, compared with the 1964 value.

Nonmetals decreased \$1.8 million, 6 percent, in value of production, mainly because of a decline in cement shipments and a drop in production of crushed sandstone for road construction. Metals de-

clined 3 percent in value (\$775,000) chiefly because of greatly reduced uranium ore output. Fuels declined 13 percent but, as the dollar value was insignificant, this decline did not affect the over-all total. The State was the leading gold producer in the Nation for the 17th consecutive year.

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Table 1.—Mineral production in South Dakota¹

Mineral	1964		1965	
	Quantity	Value (thousands)	Quantity	Value (thousands)
Cement:				
Masonry.....	thousand 280-pound barrels.....	57	55	\$180
Portland.....	thousand 376-pound barrels.....	2,001	1,575	5,127
Clays.....	thousand short tons.....	245	223	1,220
Coal (lignite).....	do.....	13	10	49
Feldspar.....	long tons.....	26,980	180	51,560
Gem stones.....	NA	20	NA	20
Gold (recoverable content of ores, etc.).....	troy ounces.....	616,913	21,592	628,259
Gypsum.....	thousand short tons.....	19	7	27
Lithium minerals.....	short tons.....	W	W	150
Mica (scrap).....	do.....	996	32	W
Petroleum (crude).....	thousand 42-gallon barrels.....	247	219	438
Sand and gravel.....	thousand short tons.....	13,770	13,998	14,155
Silver (recoverable content of ores, etc.).....	thousand troy ounces.....	133	129	167
Stone.....	thousand short tons.....	2,118	1,554	5,387
Uranium ore.....	short tons.....	110,147	44,738	303
Value of items that cannot be disclosed: Beryllium concentrate, lime, molybdenum, vanadium, and values indicated by symbol W.....		XX	XX	762
Total.....		XX	XX	50,175

W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." NA Not available. XX Not applicable.

¹ Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

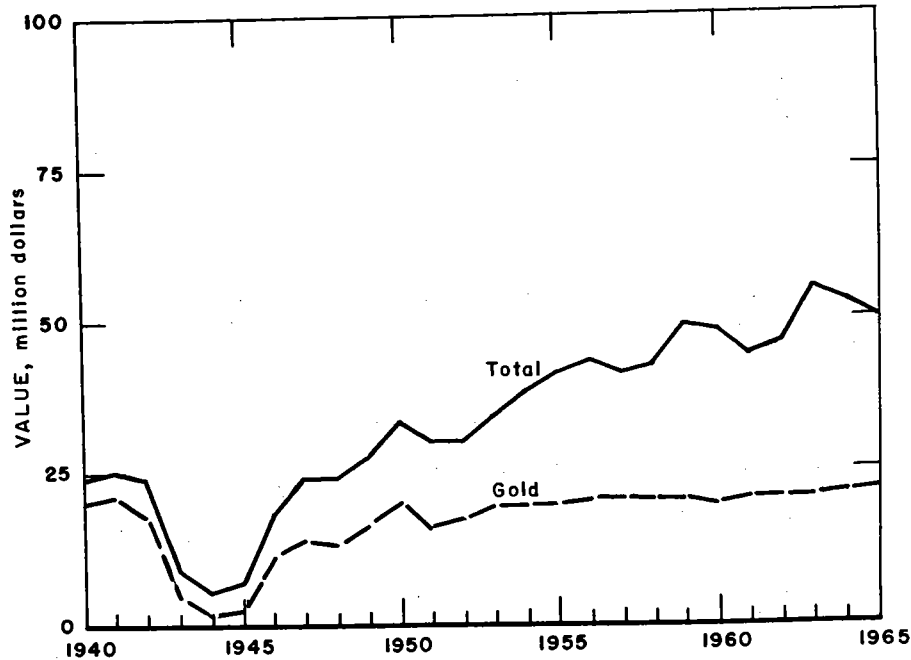


Figure 1.—Value of gold and total value of mineral production in South Dakota.

Table 2.—Value of mineral production in constant 1957-59 dollars (Thousands)

Year	Value
1956	\$41,836
1957	40,241
1958	41,733
1959	48,009
1960	46,638
1961	43,785
1962	44,378
1963	51,517
1964	49,708
1965	47,308

^r Revised.

Employment and Injuries.—Final statistics of employment and injuries in the mineral industries for 1964, excluding the petroleum industry, and preliminary data for 1965, are given in table 3.

Government Programs.—A study of the mineral industries of South Dakota was

completed by the Federal Bureau of Mines and was being reviewed for publication. The study was conducted to determine the economic factors bearing on the production, utilization, and marketing of minerals in the State. An investigation of occurrences of iron ore disclosed the probability of large resources of taconite iron ore in Pennington and Lawrence Counties.⁴ A report was published on experiments with liquid-plastic bonding of fractured rock walls at the Homestake gold mine at Lead.⁵ A joint study of the natural resources of the Black Hills by the U.S. Departments of Agriculture and Interior was nearly completed. A report was to be published in late 1966.

⁴ Harrer, C. M. Iron Resources of South Dakota. BuMines Inf. Circ. 8278, 1966, 160 pp.

⁵ Otto, Richard H., Jr. Use of Polyester-Type Resin to Stabilize Fractured Rock: A Progress Report. BuMines Rept. of Inv. 6626, 1965, 16 pp.

Table 3.—Employment and injury experience in the mineral industries

Year and industry	Average men working daily	Days active	Man-days worked (thousands)	Man-hours worked (thousands)	Number of injuries		Injury rates per million man-hours		
					Fatal	Nonfatal	Frequency	Severity	
1964:									
Coal	3	333	1	6	1	70	14.41	2,020	
Metal	2,037	302	616	4,928		9	19.12	894	
Nonmetal	225	258	58	471		28	22.70	5,519	
Sand and gravel	935	167	156	1,278	1	30	31.43	898	
Stone	500	230	115	954					
Total	3,700	256	946	7,637	2	137	18.20	2,406	
1965:^p									
Coal	5	200	1	4		32	19.04	6,621	
Metal	1,865	299	558	4,465	3	9	17.96	437	
Nonmetal	210	290	61	501		21	13.89	389	
Sand and gravel	1,130	163	184	1,512		20	24.71	7,911	
Stone	470	219	103	850	1				
Total	3,680	246	907	7,332	4	132	18.55	5,059	

^p Preliminary.

REVIEW BY MINERAL COMMODITIES

NONMETALS

Cement.—A decrease in construction activity effected a 21-percent decline in portland cement shipments from the South Dakota Cement Commission cement plant at Rapid City. Production was 61 percent of the annual plant capacity of 2.6 million barrels. Shipments of masonry cement declined 4 percent. Lower prices also contributed to a decline in the value of shipments.

Ready-mixed concrete companies received 39 percent of the portland cement shipped; highway contractors 27 percent; building material dealers 20 percent; and concrete product manufacturers, other contractors, Government agencies, and miscellaneous customers the remaining 14 percent. Sixty-three percent of the cement shipments was by railroad.

Raw materials consumed included 417,000 tons of limestone, shale, gypsum, sand, and iron ore. More than 29 million kilowatt-hours of electrical energy was used in the operation of the plant.

Clays.—American Colloid Co. produced bentonite from leased State-owned land in Butte County. The bentonite was processed at the company plant near Belle Fourche, as was crude material mined by the company in Wyoming. Bentonite from other Wyoming deposits was processed at the International Minerals & Chemical

Corp. (IMC) plant, also near Belle Fourche. Bentonite was used as a refractory in foundries and as a filler in manufacturing paper and insecticides; for reservoir, pond, and ditch lining, filtering, briquet binding, and enameling; and in preparing rotary drilling mud, animal feed, plasters, and adhesives. A substantial portion of the total output was exported.

Miscellaneous clay was produced by Black Hills Clay Products Co. The company manufactured building brick at its plant at Belle Fourche. Shale was produced by Light Aggregates, Inc., of Rapid City, for use in manufacturing lightweight aggregate and by the South Dakota Cement Commission, for manufacturing cement.

Feldspar.—A 92-percent increase was recorded in the value of feldspar output. Production was from 35 mines, 8 in Pennington County and 27 in Custer County, compared with 24 mines in 1964. All the feldspar was of the potash variety.

IMC mined or purchased most of the output, which was ground at its plant near Custer. Crude ore (handsorted or hand-picked) was shipped for special uses, principally porcelain, glass, and pottery. Other uses were for enamel and brick, and tile. Flotation concentrates were used for welding rod and in soaps and abrasives. The feldspar was shipped to users in more than 16 States and to Canada and Mexico.

Gypsum.—The South Dakota Cement Commission mined gypsum from an open-pit mine in Pennington County. The gypsum was added to portland cement to retard the rate of setting. Output declined 63 percent. This decline necessitated the use of stockpiled material and caused a decrease in cement production.

Lime.—Although the quantity of lime produced in the State declined 4 percent, a 3-percent increase in production value was recorded. Hydrated lime, most of which was used as a soil stabilizer in highway construction, was produced by Pete Lien & Sons, near Rapid City. Quicklime output was reported by the company for the first time. The plant began operations in 1964.

In Custer County, Black Hills Lime Co.

at Pringle continued to produce quicklime for metallurgical uses. In Butte County, Utah-Idaho Sugar Co. discontinued lime production used in manufacturing beet sugar at the company Belle Fourche plant. Constructed in 1927, the plant was closed in January 1965.

Lithium.—Lithium mineral output from the Ingersoll mine near Keystone, Pennington County, was 50 tons of lepidolite and 25 tons of amblygonite. L. W. Judson produced 75 tons of amblygonite from the Hugo mine, also in Pennington County.

Mica.—Output of scrap mica came from three mines near Keystone. Keystone Chemical Co. operated the Ingersoll mine, and the Northwest Beryllium Corp. operated Hugo and Peerless mines. The Peerless mine was converted entirely to

Table 4.—Sand and gravel sold or used by producers by classes of operations and uses
(Thousand short tons and thousand dollars)

Class of operation and use	1964		1965	
	Quantity	Value	Quantity	Value
Commercial operations:				
Sand:				
Construction:				
Building	381	\$395	420	\$503
Paving	301	293	200	249
Fill	20	16	39	30
Other	35	35		
Total	737	739	659	782
Gravel:				
Construction:				
Building	276	354	305	364
Paving	1,468	1,326	1,547	1,796
Railroad ballast	24	21	32	38
Fill	54	34	57	38
Other			8	8
Miscellaneous			2	1
Total	1,822	1,735	1,951	2,245
Total sand and gravel	2,559	2,474	2,610	3,027
Government-and-contractor operations:				
Sand:				
Building	12	12	(¹)	1
Paving	2,423	2,423	2,772	2,773
Other			7	6
Total	2,435	2,435	2,779	2,780
Gravel:				
Building	46	46	66	55
Paving	8,730	8,686	8,543	8,293
Total	8,776	8,732	8,609	8,348
Total sand and gravel	11,211	11,167	11,388	11,128
All operations:				
Sand	3,172	3,174	3,438	3,562
Gravel	10,598	10,467	10,560	10,593
Total	13,770	13,641	13,998	14,155

¹ Less than ½ unit.

open-pit dining. During the year both underground and open-pit methods had been used.

Table 5.—Sand and gravel production in 1965, by counties

(Thousand short tons and thousand dollars)

County	Quantity	Value
Aurora	392	\$382
Beadle	99	99
Bennett	77	77
Bon Homme	269	289
Brookings	515	543
Brown	385	464
Brule	746	747
Buffalo	4	4
Butte	347	400
Campbell	80	83
Charles Mix	475	472
Clark	232	197
Clay	62	62
Codington	653	631
Corson	758	644
Custer	8	8
Davison	173	176
Day	314	371
Deuel	135	141
Dewey	19	19
Douglas	259	266
Edmunds	70	70
Fall River	W	W
Faulk	166	166
Grant	135	135
Gregory	246	256
Haakon	30	30
Hamlin	10	17
Hand	50	50
Hanson	363	363
Harding	48	48
Hughes	67	67
Hutchinson	293	295
Hyde	25	25
Jackson	15	15
Jerauld	42	42
Kingsbury	270	268
Lake	97	99
Lawrence	179	182
Lincoln	552	561
Lyman	184	200
Marshall	136	127
McCook	659	659
McPherson	161	161
Meade	237	186
Mellette	65	65
Miner	30	30
Minnehaha	856	905
Moody	262	229
Pennington	318	325
Perkins	331	335
Roberts	404	438
Sanborn	98	87
Shannon	37	37
Spink	284	284
Stanley	27	27
Sully	108	108
Todd	26	26
Tripp	57	57
Turner	273	259
Union	209	209
Walworth	451	496
Washabaugh	47	47
Yankton	W	W
Undistributed	78	94
Total	13,998	14,155

W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

The mica was shipped to consumers in four other States. Mica was used mainly for paint and roofing materials.

Sand and Gravel.—Output of sand and gravel increased slightly. Minnehaha County led the State with a production of 856,000 tons; only Jones, Potter, and Ziebach Counties reported no production. The largest producers were Concrete Materials Co. of Sioux Falls in Minnehaha County and Liming Contracting of Belle Fourche, Butte County. Seven commercial operations in the State had an output of 100,000 tons or more.

Commercial operations, 79 in 34 counties, accounted for 19 percent of the production. There were 244 Government-and-contractor operations in 62 counties. The Government-and-contractor sand and gravel was produced for county and city highway departments, the State highway department, the U.S. Bureau of Public Roads, Federal Bureau of Indian Affairs, the U.S. Forest Service, and the South Dakota Cement Commission.

Construction gravel was 75 percent of the output, and the remainder was construction sand. The principal use for the sand and gravel was for paving (93 percent); other uses were for building, railroad ballast, and fill.

Essentially all of the sand and gravel was washed, sized, or otherwise prepared. The processing plants included 210 with portable and 23 with stationary equipment; 2 operators reported 1 of each type.

Stone.—Production of stone declined in value 14 percent. No crushed sandstone for use at Government-and-contractor operations was reported in 1965. A decline also was noted in output of crushed limestone. Partly offsetting the decline was an increase in output of dimension granite from Grant County. The granite operations at seven quarries accounted for 55 percent of the value of all stone produced in the State. Output of a small amount of dimension limestone (flagstone) in Pennington County was recorded. Crushed miscellaneous stone was produced in six counties for use as riprap and for concrete or roadstone.

All of the crushed limestone, produced for commercial use, was from eight quarries in Custer, Fall River, Lawrence, and Pennington Counties. Uses were for con-

Table 6.—Stone sold or used by producers, by kinds

Year	Granite		Limestone		Sandstone ¹	
	Short tons	Value	Short tons	Value	Short tons	Value
1961	26,476	\$2,823,441	1,378,062	\$1,939,293	984,512	\$1,493,464
1962	25,923	2,442,181	1,572,300	2,184,374	1,119,655	1,779,639
1963	24,630	2,761,546	1,652,571	2,427,016	1,033,749	2,070,837
1964	17,803	2,807,851	1,179,551	1,734,812	920,361	1,702,349
1965	20,129	2,944,586	868,726	1,411,917	650,847	1,006,609
	Other stone		Total			
	Short tons	Value	Short tons	Value	Short tons	Value
1961	417,391	\$385,953	2,806,441	\$6,642,151		
1962	² 134,056	² 126,373	2,851,934	6,532,567		
1963	82,618	79,310	2,793,568	7,338,709		
1964			2,117,715	6,245,012		
1965	14,068	24,117	1,553,770	5,387,229		

¹ Includes quartz and quartzite.

² Includes slate.

Table 7.—Stone sold or used by producers, by uses

Use	1964		1965	
	Quantity	Value	Quantity	Value
Dimension stone:				
Rough construction and rubble.....short tons			4,000	\$6,000
Rough architectural.....cubic feet	4,000	\$15,810	W	W
Dressed architectural.....do	16,410	110,136	116,335	1,869,679
Rough monumental.....do	23,000	77,190		
Dressed monumental.....do	176,382	2,604,715	131,903	2,074,907
Flagging.....do			25,000	3,000
Total (approximate, in short tons).....do	17,803	2,807,851	26,129	2,953,586
Crushed and broken stone:				
Riprap.....short tons	258,242	529,044	33,858	45,915
Railroad ballast.....do	220,958	330,974	285,167	392,220
Concrete and roadstone.....do	1,108,020	1,778,340	821,577	1,294,181
Cement.....do	431,680	647,520	312,564	562,615
Other.....do	² 81,012	² 151,283	³ 74,475	³ 138,712
Total.....do	2,099,912	3,437,161	1,527,641	2,433,643
Grand total stone (approximate, in short tons).....do	2,117,700	6,245,012	1,553,800	5,387,229

W Withheld to avoid disclosing individual company confidential data; included with "Dressed architectural."

¹ Includes rough architectural and rough monument.

² Includes stone used in asphalt filler, filter, lime, refractory, and roofing granules.

³ Includes stone used in other filler, lime, and refractory.

crete and roadstone, manufacturing cement and lime, railroad ballast, riprap, and asphalt filler. Crushed limestone for use at Government-and-contractor operations was produced in Custer County for the Federal Bureau of Reclamation, in Lawrence County for the U.S. Forest Service, and in Pennington County for the U.S. Forest Service and the State highway department.

Commercial crushed sandstone from Hanson, Minnehaha, and Tripp Counties was quarried for use as ganister, riprap, railroad ballast, and in concrete or roadstone.

METALS

Beryllium. — Beryllium concentrate (beryl) production, continuing to increase, was more than double the 1964 figure.

Production was reported from five mines in Pennington County and two in Custer County. Major producers were George Bland at the White Mica mine, Walter Hough at the Hugo mine, and Taylor Brothers at the Dan Patch mine. All of the beryl was purchased by Beryl Ores Co. of Arvada, Colo.

Gold and Silver. — Gold production reached an alltime high at the Homestake Mining Co. operations at Lead, Lawrence County. Value of gold output increased 2 percent; tonnage of ore processed was essentially unchanged. Recovered value of bullion was \$10.88 per ton of ore, compared with \$10.68 in 1964. Metallurgical recovery was 95.7 percent, a slight decrease from the 1964 figure. Amalgamation accounted for 68 percent of the recovered gold; the remaining 32 percent was recovered by cyanidation. A 3-percent decrease was noted in the production of silver, also from the Homestake mine.

All of the State production of gold and silver was from the Homestake mine.

Iron Ore. — Iron ore, previously mined from deposits near Nemo and stockpiled, was used in manufacturing cement at Rapid City. None was produced in 1965.

Molybdenum. — Overall State production of molybdenum increased 148 percent. Treatment of ash from lignite coal yielded all the molybdenum produced in the State. The lignite, from mines in Harding County, was mined principally for its uranium content with molybdenum as a byproduct. The ash was shipped to the Kerr-McGee Corp. uranium mill in New Mexico for treatment.

Uranium. — With 22 fewer mining operations than in 1964, output of uranium ore declined 59 percent. The number of operations dropped from 5 to 2 in Custer County, from 29 to 19 in Fall River County, and from 15 to 6 in Harding County. The decrease in production was accompanied by a decline in average grade of ore mined, from 0.19 percent to 0.12 percent U₃O₈. Because of lower production and grade, value of ore output was only 20 percent of the 1964 figure.

Production included sandstone ores mined in Custer and Fall River Counties and uraniumiferous lignite mined in Harding County. The sandstone ores and ash from some of the lignite were treated at the Edgemont uranium mill operated by

Mines Development, Inc., a subsidiary of Susquehanna-Western, Inc. Other ash was shipped to a New Mexico uranium mill, and a small amount of lignite was shipped to North Dakota for burning and subsequent processing at a Colorado uranium mill.

Sandstone ores from Wyoming and lignite ores from North Dakota also were treated at the Edgemont mill. The Government purchase contract was to expire December 31, 1966.

Vanadium. — Vanadium oxide was recovered as a coproduct at the Edgemont uranium mill operated by Mines Development, Inc. Vanadium was contained in sandstone uranium ores mined in Custer and Fall River Counties and in Wyoming. Tailings from the uranium operations were treated by the solvent-extraction method to dissolve the vanadium, which was recovered by precipitation. The concentrate, after conversion to fused vanadium oxide (black flake), was shipped in drums to consumers. The quantity recovered declined mainly because of decreased uranium ore output.

MINERAL FUELS

Coal (Lignite). — Coal (lignite), other than uraniumiferous lignite, was mined by Dewey Coal Co. at a strip mine near Firesteel. Production was from the 54-inch-thick Hellcreek seam, which is overlain by 25 to 35 feet of overburden.

Petroleum. — Production of crude petroleum was 218,876 barrels, valued at \$438,000, down 12 percent from the value in 1964; of this quantity, 189,538 barrels was from 24 wells in the Buffalo field, Harding County, and the remainder from 4 wells in the Barker Dome field, Custer County. Buffalo field also yielded 13.5 million cubic feet of natural gas, used for field fuel or flared.

At the three lease sales of State acreage, a total of 379,505 acres was leased for bonus payments of \$43,508. In addition, 25,465 acres of Indian lands was leased for a bonus of \$40,998. At yearend, 717,650 acres of Federal lands and 59,022 acres of Indian lands were under lease.

Drilling activity increased as 33 wells were drilled compared with 26 in 1964. Exploratory drilling accounted for 29 of the wells in 1965; all of the exploratory wells were unsuccessful. At yearend 1964, a

wildcat well, drilled by Pendac, Ltd., in Dewey County, had reportedly yielded oil and water on tests of the Red River formation (Ordovician). Because further testing in early 1965 indicated that the production was noncommercial, the well was plugged and abandoned.

Gulf Oil Corp. drilled nine exploratory wells during the year. Eight of the wells, in the southcentral part of the State, ap-

parently were attempts to evaluate the stratigraphic trap possibilities of the Paleozoic formations wedging-out against the Siouxi Landmass in the southeastern part of the State.

The Kanab Pipe Line Co. extended its 6-inch products pipeline 175 miles from Wolsley to Jamestown, N. Dak. It also built a 166-mile, 8-inch loop from Geneva, Nebr., to Yankton, S. Dak.

Table 8.—Mine production of gold and silver in terms of recoverable metals

Year	Mines producing		Material sold or treated ¹ (thousand short tons)	Gold (lode and placer)		Silver (lode and placer)	
	Lode	Placer		Troy ounces	Value (thousands)	Troy ounces (thousands)	Value (thousands)
1956-60 (average).....	2	-----	1,778	567,997	\$19,880	131	\$119
1961.....	2	-----	1,781	557,855	19,525	127	118
1962.....	2	-----	1,869	577,232	20,203	113	123
1963.....	3	1	1,909	576,726	20,185	117	150
1964.....	1	1	2,033	616,913	21,592	133	172
1965.....	1	-----	2,032	628,259	21,989	129	167
1876-1965.....	NA	NA	NA	31,207,892	873,873	12,137	9,287

NA Not available.

¹ Excludes placer gravel.

Table 9.—Drilling for petroleum in 1965, by counties

County	Oil	Dry	Total	Footage
Exploratory completions:				
Butte.....	-----	5	5	21,773
Corson.....	-----	1	1	5,000
Dewey.....	-----	2	2	10,759
Fall River.....	-----	11	11	25,322
Haakon.....	-----	1	1	5,000
Harding.....	-----	1	1	3,961
Jackson.....	-----	1	1	3,334
Jones.....	-----	3	3	8,600
Lyman.....	-----	1	1	2,100
Meade.....	-----	1	1	4,673
Spink.....	-----	1	1	945
Stanley.....	-----	1	1	4,000
Total.....	-----	29	29	95,467
Development completions:				
Custer.....	1	-----	1	1,349
Harding.....	3	-----	3	25,637
Total.....	4	-----	4	26,986
Total all drilling.....	4	29	33	122,453

Source: Oil and Gas Journal.

REVIEW BY COUNTIES

Mineral output was reported by 64 of the 67 counties. Jones, Potter, and Ziebach were the only counties not having production. However, only those counties with significant production or activity in the mineral industry are discussed.

Butte.—Bentonite was the principal mineral commodity produced. American Colloid Co. operated its processing plant at Belle Fourche, using raw material from Wyoming as well as from a State-owned deposit in the county. IMC processed Wyoming bentonite at the company Belle Fourche plant. The principal use was for refractories in foundries.

Other clay was produced by Black Hills Clay Products Co., also at Belle Fourche, for manufacturing building brick.

Lime production ended when Utah-Idaho Sugar Co. closed its beet sugar refinery in January. The plant had been opened in 1927.

Sand and gravel, from 11 operations, was produced, principally for paving. Value of all mineral commodities increased 40 percent; increased clay and sand and gravel output offset the effect of the ending of lime production.

Custer.—Decreases were recorded in the production of petroleum, sand and gravel, stone, uranium ore, and vanadium. Only feldspar and lime showed increases. The net effect of the changes was a 24-percent decline in mineral output value. Resumption of beryllium concentrate production did not significantly affect the county mineral production total.

Feldspar from 27 operations, 8 more than in 1964, was mined or purchased by IMC and ground at the company Custer plant. Major mines were the Shamrock, Tip Top, and White Elephant. George Bland and J. D. Morgan sold beryllium concentrates (beryl) to Beryl Ores Co.

Uranium ore and associated vanadium production declined considerably because mines were closed and output was curtailed. Uranium ore purchase contracts were to expire in 1966. Mining operations decreased from five to two. Black Hills Uranium Co. and Susquehanna-Western, Inc., shipped ore to Edgemont for milling.

Limestone was quarried for manufacturing lime by Black Hills Lime Co. near Pringle. Hills Materials Co. mined lime-

stone for use as riprap and in concrete or roadstone. The Federal Bureau of Reclamation used limestone, produced by contractors, as riprap. A small amount of sand and gravel output was used for paving.

Crude oil production at the Barker Dome field declined by 44 percent, to 29,338 barrels for the year. The field yielded oil from the First Leo sandstone (Pennsylvanian) at a depth of about 1,400 feet.

Fall River.—Value of mineral production declined 47 percent. Output of all commodities decreased.

Oral Sand Co. and Flyte Sand and Gravel Co. produced sand and gravel for building construction. Flyte Rock Products produced crushed limestone for use in concrete or roadstone.

Uranium ore, produced from 19 operations, 10 less than in 1964, was shipped to the Edgemont mill of Mines Development, Inc., for treatment to recover uranium and vanadium concentrates. Shippers were Susquehanna-Western, Everett Chord, Roy Chamberlain, Robert E. Gull, and Melvin Hanson. Other sandstone ores from Custer County and two Wyoming counties also were treated at the mill. Uranium-bearing lignite ash from Harding County and two North Dakota counties was processed at the plant. Although shipments of molybdenum had been noted in 1964, none was reported as recovered from the ash in 1965.

The county again had the largest number of exploratory oil well completions in the State—11 wells, the same number as in 1964.

Granit.—Output of granite from seven quarries near Milbank and Big Stone City was valued at \$2.9 million, an increase of 5 percent. Production of sand and gravel more than doubled.

Granite was quarried near Milbank and Big Stone City for use as architectural and monumental stone. Producers were Cold Spring Granite Co., Dakota Granite Co., Delano Granite Works, Inc., North Star Granite Corp., Robert Hunter Granite Co., Inc., and Steiner-Rausch Granite Co. Most of the granite was shipped to Minnesota plants for finishing.

Harding.—Value of mineral production declined by \$1.3 million, or 60 percent,

Table 10.—Value of mineral production in South Dakota, by counties¹

County	1964	1965	Minerals produced in 1965 in order of value
Aurora.....	\$205,000	\$382,000	Sand and gravel.
Beadle.....	404,000	99,000	Do.
Bennett.....	187,000	77,000	Do.
Bon Homme.....	191,000	289,000	Do.
Brookings.....	247,000	543,000	Do.
Brown.....	580,000	W	Sand and gravel, stone.
Brule.....	1,036,000	752,970	Do.
Buffalo.....	116,000	4,000	Sand and gravel.
Butte.....	W	W	Clays, sand and gravel.
Campbell.....	2,000	93,000	Sand and gravel.
Charles Mix.....	533,000	474,480	Sand and gravel, stone.
Clark.....	220,000	197,000	Sand and gravel.
Clay.....	75,000	62,000	Do.
Codington.....	124,000	631,000	Do.
Corson.....	450,000	644,000	Do.
Custer.....	614,380	464,628	Feldspar, petroleum, lime, stone, uranium ore, sand and gravel, vanadium, beryllium concentrate.
Davison.....	93,000	176,000	Sand and gravel.
Day.....	328,000	371,000	Do.
Deuel.....	70,000	141,000	Do.
Dewey.....	162,050	87,700	Coal, sand and gravel.
Douglas.....	237,000	286,000	Sand and gravel.
Edmunds.....	414,000	70,000	Do.
Fall River.....	474,893	250,187	Vanadium, uranium ore, sand and gravel, stone.
Faulk.....	89,000	186,000	Sand and gravel.
Grant.....	2,863,851	3,079,586	Stone, sand and gravel.
Gregory.....	75,000	256,000	Sand and gravel.
Haakon.....	50,000	30,000	Do.
Hamlin.....	13,000	17,000	Do.
Hand.....	25,000	50,000	Do.
Hanson.....	522,575	969,781	Stone, sand and gravel.
Harding.....	2,117,697	838,689	Petroleum, uranium ore, molybdenum, sand and gravel.
Hughes.....	89,000	70,608	Sand and gravel, stone
Hutchinson.....	353,100	295,000	Sand and gravel.
Hyde.....	198,000	25,000	Do.
Jackson.....	89,000	15,000	Do.
Jerauld.....	174,000	42,000	Do.
Kingsbury.....	172,000	268,000	Do.
Lake.....	172,000	99,000	Do.
Lawrence.....	22,122,992	22,381,179	Gold, sand and gravel, silver, stone.
Lincoln.....	160,000	561,000	Sand and gravel.
Lyman.....	151,000	200,000	Do.
Marshall.....	228,000	127,000	Do.
McCook.....	138,000	659,000	Do.
McPherson.....	114,000	161,000	Do.
Meade.....	310,000	186,000	Do.
Mellette.....	15,000	65,000	Do.
Miner.....	105,000	30,000	Do.
Minnehaha.....	2,192,098	1,239,430	Sand and gravel, stone.
Moody.....	615,000	229,000	Sand and gravel.
Pennington.....	9,622,948	7,557,035	Cement, stone, lime, sand and gravel, clays, mica (scrap), feldspar, gypsum, lithium, beryllium concentrate.
Perkins.....	200,000	335,000	Sand and gravel.
Potter.....	116,000	438,000	Sand and gravel.
Roberts.....	391,000	87,000	Do.
Sanborn.....	50,000	37,000	Do.
Shannon.....	37,000	284,000	Do.
Spink.....	269,000	27,000	Do.
Stanley.....	47,000	108,000	Do.
Sully.....	78,000	26,000	Do.
Todd.....	W	W	Stone, sand and gravel
Tripp.....	418,000	259,000	Sand and gravel.
Turner.....	95,000	209,000	Do.
Union.....	150,000	496,000	Do.
Walworth.....	74,000	47,000	Do.
Washabaugh.....	181,000	W	Sand and gravel, stone.
Yankton.....	1,349,866	2,160,044	
Undistributed ²			
Total.....	52,824,000	50,175,000	

¹ Revised. W Withheld to avoid disclosing individual company confidential data; included with "Undistributed."

² Jones and Ziebach Counties not listed because no production was reported.

³ Includes production of gem stones and some beryllium concentrate (1964) that cannot be assigned to specific counties, and values indicated by symbol W.

because of decreased petroleum, uranium ore, and sand and gravel output. Output of molybdenum, contained in uranium-bearing lignite ash, was the only mineral commodity that increased (195 percent).

Production at the Buffalo oilfield declined slightly (3 percent) from that of 1964. Three more producing oil wells were completed in the field, bringing the total number to 24 on December 31, 1965.

Uraniferous lignite was burned under controlled conditions to yield an ash containing uranium and molybdenum. Burning was done at either portable or stationary burners. (The nearest stationary burner was that of Kerr-McGee Corp., near Bowman, N. Dak.) At the Kerr-McGee mining operations, near Ludlow in the North Cave Hills, the lignite was in a bed 6 inches to 2-feet thick and overlain by up to 110 feet of overburden. The lignite lay on top of the basal Tongue River member of the Fort Union formation (Paleocene). This hard sandstone provided a floor for scooping off the lignite with little dilution by barren rock. Overburden was easily stripped by scrapers and bulldozers to within approximately 1 foot of the lignite. A self-loading pan then completed the removal. A small front-end loader removed small pockets of ore not recovered by the larger machines.⁶

Susquehanna-Western, Inc., mined uraniumiferous lignite, which was burned in place, and shipped the ash to Edgemont for treatment. W. L. Munkers shipped ore to the Union Carbide Corp. burner near Belfield, N. Dak.

Lawrence.—The county led the State in value of mineral production (\$22.4 million). All of the gold and silver produced

in the State was from the Homestake mine. Gold production increased 2 percent; silver decreased 3 percent.

According to the annual report to the Homestake Mining Co. stockholders, progress was made in the program to mine below the 4,850-foot level; the planned objective of 250,000 tons per year of ore was exceeded for the first time. Problems of grade and cost controls prompted early development of this lower area. Development drilling during the year found several prospective mining areas; the company announced a very substantial discovery of above average grade ore between the 5,300- and 6,800-foot levels.

According to the annual report, the measured ore reserves on December 31, 1965, was 16.4 million tons, with an estimated millhead grade of 0.315 ounces (\$11.01) of gold per ton. In addition, an indicated reserve of 761,000 tons was estimated at \$12.70 per ton.

The Brookhaven National Laboratories obtained permission from Homestake to conduct underground research on neutrinos, nuclear particles discharged from the sun. The experimental area was on the 4,850-foot level of the Homestake mine, where a tank chamber 30 feet by 65 feet and 32 feet high was excavated to hold a 100,000-gallon tank of perchloroethylene, containing chlorine. The neutrinos strike the chlorine atoms, changing them to radioactive argon-37 that can be quantitatively measured. The underground location enables a screening out of unwanted cosmic rays.

⁶ Metal Mining and Processing. V. 2, No. 3, March 1965, pp. 18-20.

Table 11.—Homestake mine ore milled, receipts, and dividends¹

Year	Ore milled (thousand short tons)	Receipts for bullion product		Dividends (thousands)
		Total (thousands)	Per ton	
1961.....	1,781	\$19,590	\$11.00	\$4,030
1962.....	1,869	20,271	10.85	3,242
1963.....	1,909	20,278	10.62	3,265
1964.....	2,033	21,703	10.68	3,288
1965.....	2,032	22,094	10.88	3,445

¹ From 1876 to 1965, inclusive, this mine yielded bullion and concentrates that brought a net return of \$802 million and paid \$228.1 million in dividends.

Source: Homestake Mining Co. annual report to stockholders.

Other mineral commodities produced in the county were sand and gravel and stone. Sand and gravel was produced at six operations. Contractors provided material for the State and county highway departments; Cole Construction Co. mined sand and gravel for commercial use. The company also produced crushed limestone, as did Northwestern Engineering Co., a contractor for the Federal Forest Service.

Pennington.—Mineral production declined 22 percent in value or more than \$2 million. Most of the decline was due to decreased cement shipments; however, production decreases also were noted for clays, gold, gypsum, lithium, sand and gravel, and stone. Mineral commodities showing increases were beryllium concentrates (beryl), feldspar, and scrap mica, all from pegmatite mines. Lime production also increased.

The clay (shale), gypsum, sand, and limestone, used to manufacture cement, were produced near the State-owned cement plant at Rapid City. Other clay was used for manufacturing lightweight aggregates. Limestone, other than that used for cement manufacture, was produced by Hills Materials Co., L. G. Everist,

Inc., and Pete Lien & Sons. Uses were for highway construction, riprap, railroad ballast, flagstone, and for manufacturing lime. The lime was produced by Pete Lien & Sons at a plant near Rapid City. Most of the output from the 2-year-old plant was used as a soil stabilizer in road construction.

Portions of the Hugo mine, operated by L. W. Judson, Walter Hough, and Northwest Beryllium Corp., were the source of beryllium, feldspar, lithium, and mica. These minerals also were produced at the Ingersoll mine by Keystone Chemical Co., and, except for lithium, at the Peerless mine by Northwest Beryllium Corp. Beryllium output was reported from five operations and feldspar from eight. Value of pegmatite production increased 101 percent. Northwest Beryllium Corp. continued to operate its flotation mill at Keystone.

Sand and gravel was produced at 20 operations. Government users were the U.S. Bureau of Public Roads, U.S. Forest Service, South Dakota Cement Commission, and State and county highway departments. Commercial operation was by Wasta Sand and Gravel.